

Harold S. Johnson

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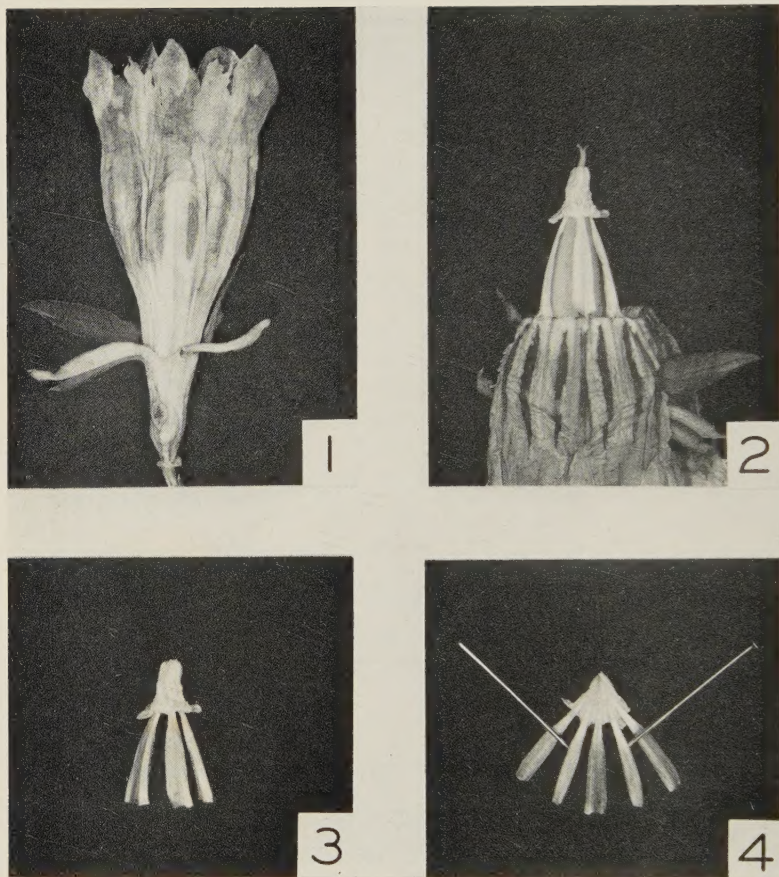
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GENTIANA CATESBAEI: FIG. 1. Flower, slightly compressed. FIG. 2. Flower with corolla turned down to point of attachment of filaments. FIG. 3. Stamens, separated from corolla at point of attachment to corolla, the united anthers holding filaments in original position. FIG. 4. Stamens, the cone formed by united anthers being split down one side and opened to show the inner surface of the cone, i. e., the side nearest the pistil.

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CONNATE ANTHERS IN GENTIANA (GENTIANACEAE)

WILBUR H. DUNCAN AND CLAUD L. BROWN

FEW families of angiosperms have taxa with united anthers. East of the Mississippi River, an amateur or beginning student soon learns that united anthers are characteristic of the *Compositae* (Ambrosiaceae, Carduaceae, Cichoriaceae) and certain *Campanulaceae*, especially *Lobelia*. Such a student is much less likely to learn that certain taxa in the *Solanaceae* and *Gentianaceae* may also possess united anthers. A review of the treatment of this characteristic in the *Gentianaceae* by various authors is pertinent here.

Fernald (1950) does not mention this characteristic in his synopsis of the *Gentianaceae* or of the genus *Gentiana* which has several species with united anthers. Fernald's key to the species of *Gentiana* does indicate that 12 species have or may have "anthers cohering in a ring or short tube," and that in one species "anthers not connected." For ten species, however, there are no data in regard to united anthers. Descriptions of the species add no further light except for *G. puberula* Michx. where it is stated "anthers separate or promptly separating." None of the illustrations shows anthers.

The "New Britton and Brown Illustrated Flora," Vol. 3, (H. A. Gleason, 1952) is not clear in regard to existence of united anthers in some taxa of *Gentiana*. In the synopsis of the family we find "anthers free or connate." In the synopsis of *Gentiana* we find "anthers separate, connivent, or connate." In the key to the species, as with Fernald (1950), there is nothing

concerning union of anthers for a number of species (six), two species being given as having "anthers separate and distinct," and 10 species as having "anthers connivent or coherent in ring." Descriptions of the species add nothing. In the illustrations of the 10 species (indicated by the key as having anthers connivent or coherent in a ring) stamens are not shown in two species. Stamens are shown for eight species but are illustrated as being separate.

Small (1933) gives no data on the subject in the synopsis of the *Gentianaceae*, *Gentianella* (*Gentiana*), or *Dasystephana* (*Gentiana*), but in the key to the species of the latter genus are the following: one species, "anthers separate"; seven species, "anthers cohering in a tube or ring"; and two species, no data. The illustration for each of the two genera, in so far as we are able to determine, is in each case that of a species not having united anthers. Other species are not illustrated.

In the three major manuals covering the eastern United States, therefore, there is no way to determine for a number of taxa in *Gentiana*, whether or not anthers are united. Furthermore, united anthers, which are a useful diagnostic character for several species, are nowhere illustrated.

In Deam's (1940) "Flora of Indiana" and Jones' (1945) "Flora of Illinois" there is no synopsis for the *Gentianaceae* or *Gentiana*, and there are no illustrations. In the keys, reference to union of stamens is made in case of only two and three species, respectively. These two state floras, too, lack data on union of stamens for most taxa in *Gentiana*. The same is true for western floras. From data contained in Rydberg's (1906) "Flora of Colorado," Jepson's (1939) "A Flora of California," Kearney's (1951) "Arizona Flora," and Abrams' (1951) "Illustrated Flora of the Pacific States" I am unable to determine whether any taxa have united anthers although from the illustrations in Jepson's flora it may be concluded that they were separate for all twelve species listed. The same is true for the two species that have illustrations of stamens in Abrams' flora.

A recent and most excellent book, "Taxonomy of Vascular Plants" (Lawrence, 1951), also omits reference to union of anthers in *Gentiana*. This is especially misleading since Lawrence states "stamens—epipetalous, distinct (syngenesious in

Voyria and *Leiphaimos* spp.).” The genus *Gentiana* obviously should have been included with the other two.

Britton & Brown (1897 and 1913) give for four *Gentiana* (incl. *Dasystephana*) species illustrations that show united anthers. The text of each edition includes information concerning this character for a number of species. Information concerning this character is lacking, however, for other species. Torrey (1843) has excellent illustrations of connate anthers for two species. The trend seems to have been from considerable emphasis on connate anthers in early American botanical works to very little reliance on the character in recent publications.

It would be helpful to indicate here for the eastern North American taxa of *Gentiana*, in particular, whether or not the anthers are united, and, if so, to what extent. Such is not easily possible, for the proper application of names seems impossible for us at this time. Fernald (1950) and Gleason (1952) list different taxa for the genus, and herbarium material at our disposal is not adequate for such a study.

Material of several taxa was examined, however, and in view of the lack of illustrations of connate anthers in recent, major floras or taxonomy texts, photographs were made for purposes of publication. The photographs shown (figs. 1–4) are of *Gentiana catesbaei* Walt. [*Dasystephana latifolia* (Chapm.) Small]. The prominence of the characteristic, union of anthers, is readily evident. It may be noted that the anthers dehisce outwardly, that is, away from the pistil.

From the present study it is evident that adequate morphological data are unavailable for *Gentiana*, and that in the treatments of *Gentiana* in recent floras the union of anthers is treated as a characteristic of minor repute. It seems, however, that in a detailed study of the genus, and perhaps the entire family, special attention to union of anthers might furnish important clues as to relationships of taxa of various levels. In other words, even though the character might not be useful for keys there is some evidence that it may be an important phylogenetic one. Detailed study may even amend for certain species of *Gentiana*, statements such as “anthers connate later separate” to “anthers connate in longstyled forms, separate in shortstyled (or the reverse)” for Gilg (1895) in Engler and Prantl points

out that the anthers are fastened one to another in longstyled flowers of *Hockinia* (Gentianaceae).

The authors wish to thank Mr. Haskell Venard, Atlanta, Georgia for helpful suggestions. Financial support was provided through Dr. George H. Boyd, Dean of the Graduate School, University of Georgia.

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STUDIES IN FRUTESCENT LECIDEACEAE
(LICHENIZED DISCOMYCETES)

I. MACKENZIE LAMB

[Continued from p. 129]

TONINIA Mass. emend. Th. Fr.

Toninia conglomerata (Ach.) Boist. Nouv. Flore Lich., Part 2 (1902) p. 105. Syn. *Lecidea conglomerata* Ach., Lichenogr. Univ. (1810) p. 201. *Thalloidima conglomeratum* Mass., Ricerch. Auton. Lich. Crost. (1852) p. 97. *Thalloedaema conglomeratum* Vain., Lichenogr. Fennic. II (1922) p. 145.

MATERIAL EXAMINED: Austria, Styria, Judenburg, "in saxis alpium," coll. *Welwitsch*, no date, 254, in Farlow Herb., s.n. *Thalloidima conglomeratum*.

The outward morphology of this not uncommon alpine species has been well and accurately described by Vainio, *loc. cit.* He mentions its caulescent habitus, its peculiar light-edged squamules, and its predominantly simple spores. Therefore only its anatomical characteristics will be considered in detail here, based on an examination of the Austrian specimen mentioned above.

The stipitate squamules are bicolorous, with gray edges and brownish centers. Squamules in section covered on upper side by a colorless, clear, amorphous or faintly horizontally striated, necrotic stratum 10–50 μ deep. Cortex at sides of squamule 30–70 μ thick, gradually $\pm$ dark brown in outer 15–18 μ and also $\pm$ heavily interspersed with sordid yellow-brownish depsidone-granules, which make the structure very indistinct; after treatment with KHO the cortex seems to be composed of intricated, conglutinated, gelatinous hyphae, forming on the outer surface distinct brown-pigmented cells like the heads of paraphyses. Cortex directly subtended by the algal stratum. In the center of the squamule the brown-pigmented outer layer is absent, and the cortex is greatly thickened to form a lentiform or bowl-shaped structure about 170 μ deep, which pushes the algal stratum downwards; in its upper half this structure is heavily interspersed with masses of brownish-yellow depsidone-substance, in its lower half it is colorless and hyaline, very gelatinized, with the thread-like, branched and reticulating hyphal lumina (about 1 μ wide) well visible in the clear gelatinous matrix. Medulla PD + orange-red or testaceous-red (also in other specimens examined, e.g. Rabenhorst, Lich. Europ. no. 738), the margins of the squamules also often staining. In KHO added to sections of the thallus under the microscope, the brownish-yellow depsidone-granules dissolve with effusion of yellow mist.

The radicate stipes are solid, devoid of algae, ecorticate or in places with a rudimentary and indistinct cortical layer up to 30 μ thick nubilated in its outer part with depsidone-granules. Internal medullary tissue $\pm$ colorless

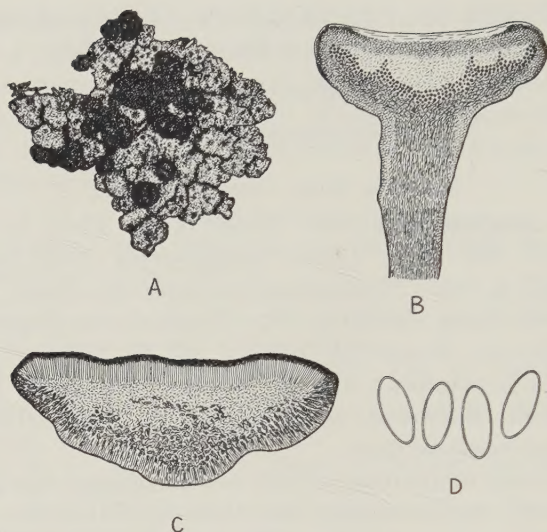


FIG. 8. *Toninia conglomerata* (Ach.) Boist. Specimen from Austria, Judenburg, coll. Welwitsch. A, part of thallus with apothecia ($\times 2$). B, vertical section of a stipitate squamule. C, vertical section of apothecium. D, spores.

and clear, composed of indistinct gelatinized hyphae $2-3\ \mu$ thick closely compacted and running mainly longitudinally parallel.

The symbiotic algae of the thallus are cystococcoid, bright green, globose, separate, thin-walled, $5.0-8.5\ \mu$ diam.

Excipulum entire at sides and below apothecium, $85-135\ \mu$ thick, sordid pale yellowish or $\pm$ colorless or isabelline in section, with irregular streaks of sordid yellow-brownish depsidone-substance between the hyphae; of flabellate-radiating structure, with parallel, conglutinated, gelatinized, thick-walled hyphae, only the fistulose lumina visible, $1.0-1.3\ \mu$ wide. Central cone tissue (myelohyphic stratum) developed in lower part of apothecium, about $200\ \mu$ deep, lax, interspersed with cloudy masses of yellowish-gray granular substance, the hyphae colorless, $3-5\ \mu$ thick, loosely intricated in various directions. Hypothecium up to $200\ \mu$ deep, colorless, hyaline or in places interspersed with irregular inclusions of sordid yellowish depsidone-substance, in the upper subhymenial part slightly sordid yellowish-cloudy; of compact gelatinized texture, with completely fused hyphae running in various directions, only the branching fistulose lumina visible, $1.0-1.3\ \mu$ wide. Hymenium $50-60\ \mu$ high, gradually or $\pm$ abruptly olivaceous brown-blackish in uppermost $8-12\ \mu$ (HNO_3 + purple-crimson), otherwise colorless and hyaline. Paraphyses discrete under pressure in water, $1.3-2.0\ \mu$ thick, not articulated, simple or sparingly branched, clavate-capitate up to $3-4$ (-5) μ at the pigmented tips. Asci clavate, $40-48 \times 12-14\ \mu$, with wall about $1\ \mu$ thick at sides, at apex gelatinously thickened up to $7\ \mu$. Spores 8 in ascus, irregularly biseriate; all simple and unseptated, ellipsoid to elongate-ellipsoid, $9-13 \times (3.5-)$ $4-5\ \mu$. Hymenium persistently blue with Iodine. KHO added to sections of apothecium dissolves the depsidone-inclusions of excipulum and hypothecium with effusion of intense yellow mist.

This species stands on the borderline between *Toninia* and *Lecidea* sect. *Psora*, the spores being in many specimens, like the above, all eseptate. Zahlbruckner, Cat. Lich. Univ. IV (1926) p. 286, lists *Lecidea acerrulata* Nyl. as a synonym, but according to Vainio's revision of the type, the latter is identical with *Toninia aromatica* (Turn.) Mass. (25, p. 133). The light-edged squamules of *T. conglomerata* resemble those of another European species, *T. nigrescens* Anzi, which is however quite distinct, having cylindric-fusiform, 3-septate spores $22 - 26 \times 3.0 - 3.5 \mu$ (e. g. in Anzi, Lich. Rar. Langob. no. 116), and a negative reaction with Paraphenylenediamine.

Toninia bumamma (Nyl.) Zahlbr. Cat. Lich. Univ. IV (1926) p. 263. Syn. *Lecidea bumamma* Nyl. in Journ. Linn. Soc. Lond., Botan. XV (1876) p. 177. *Lecidea styloumena* Stirt. in Trans. Glasgow Soc. Field Natural. V (1877) p. 217.

MATERIAL EXAMINED: the type-specimen of "*Lecidea styloumena*" Stirt. from South Africa, Somerset East, Klein Vischrivier, "in rimis rupium brecciarum ad ripas aridas," coll. P. McOwan, in herb. Stirton, Glasgow Museum.

On soil. Thallus of crowded, turgid squamules 1-3 mm. diam., produced downwards on the under side into stalk-like, $\pm$ cylindrical, rooting structures $\pm$ buried in the soil and up to 8 mm. long. Squamules up to 1 mm. thick, convex, glebose, round or $\pm$ irregular in outline, not angulose, smooth, naked, now alutaceous or sordid brownish-yellow ("albidus vel pallidus vel pallide cervinus" in fresh condition, acc. to Stirton), matt. Under side concolorous or paler, ecorticate, usually not well visible on account of adherent soil particles. Radicate stipes arising from center or near edge of underside of squamules, whitish to brownish, ecorticate, somewhat fibrous, 0.3-0.8 mm. thick, conspurcated by adherent soil. Thallus externally KHO— or brownish (Nylander reports KHO + yellow in his material), CaCl_2O_2 —, PD —. Medulla white, KHO — or faintly yellowish, CaCl_2O_2 —, PD —. Apothecia superficial on squamules, one or several to a squamule, separate or 2-3 confluent, adpressed-sessile, not or hardly constricted at the base, convex and immarginate from the first, up to 0.8 (-1.0) mm. diam., black, matt or subnitid, not pruinose. Pycnidia rather abundant, indicated externally by minute, scattered, non-prominent, black spots on upper side of squamules.

Squamules corticate on upper side only. Cortex 60-70 μ thick, in outer half densely yellow-brownish-nubilated and opaque in section, in inner half clear and colorless, pseudoparenchymatous, of $\pm$ isodiametric or oblong, obtusely angulose or rounded cells 3-6 μ diam., their walls about 1 μ thick, in KHO seen to be formed from vertical hyphae. Algal stratum $\pm$ continuous, 45-65 μ deep. Algae cystococcoid, now pale yellowish green, round, thin-walled, 6-11 μ diam. Medulla loosely hyphose, clear and colorless or in places slightly yellowish-gray-cloudy, I —, of loosely intricated, thin-

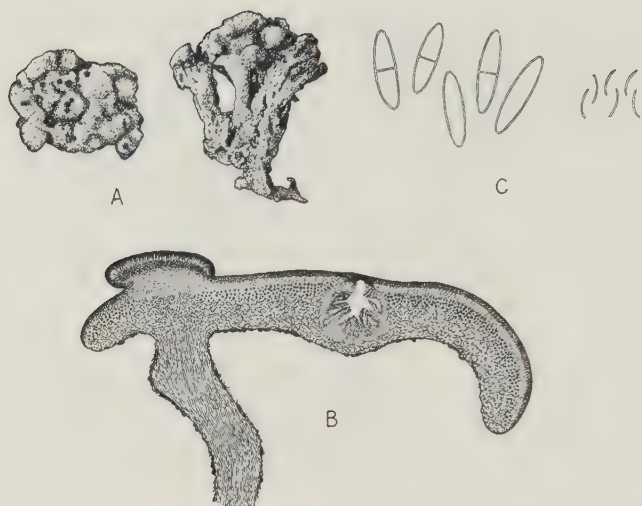


FIG. 9. *Toninia bumamma* (Nyl.) Zahlbr. The type-specimen of "*Lecidea styloumena*" Stirt. A, part of thallus seen from above and from the side ($\times 2$). B, vertical section of a stipate squamule bearing an apothecium and a pycnidium. C, spores and pycnoconidia.

walled hyphae $3.0\text{--}4.5\ \mu$ thick running in various directions. Lower side of squamules formed by the somewhat more compacted medullary hyphae, with adherent substratum-particles. Small colonies of Nostocoid blue-green algae occur occasionally on the underside of the squamules; in some cases they are superficial, but sometimes $\pm$ enclosed by medullary hyphae. Stipes devoid of algae, ecorticate, sordid yellowish or pale brownish in section, formed of compacted, mainly longitudinally running medullary hyphae, more loosened and spreading on the outer side. The nubilation of the outer cortex of the squamules dissolves in KHO with yellow mist.

The apothecia rest with a broad base on compact thallus tissue (apparently lower part of cortex), and the algal layer is interrupted beneath them. In places where an apothecium is about to be formed, the cell walls of the cortex take on a blue-green tinge. Excipulum rudimentary, indistinct, dark blue-green or aeruginose-fuliginous, formed by the sterilized margin of the hymenium, into which it is gradually transformed. Hypothecium $60\text{--}90\ \mu$ deep, unevenly pale sordid brownish or purple-brownish in section (KHO + violet-reddish), $\pm$ pseudoparenchymatous, with $\pm$ isodiametric cells about $3\ \mu$ diam., their walls gelatinously fused and somewhat indistinct. Hymenium $65\text{--}75\ \mu$ high, irregularly dark aeruginose or blue-green-blackish in uppermost $9\text{--}18\ \mu$ (KHO $-$, HNO_3 + sordid violet-red), otherwise $\pm$ colorless or partly sordid isabelline; grading without sharp limit into the hypothecium. Paraphyses $\pm$ concrete, rather stout, $1.5\text{--}2.5\ \mu$ thick, at the dark aeruginose tips gradually $\pm$ swollen (up to $4\ \mu$) and there strongly conglutinated; simple or sparingly branched, not anastomosing, not articulated; in KHO becoming $\pm$ discrete, but apparently much gelatinized. Whole hymenium persistently blue with Iodine. Asci clavate, $45\text{--}65 \times 11\text{--}13\ \mu$, with gelatinous wall about

1.5 μ thick at sides, 8–15 μ at apex. Spores 8 (or apparently often fewer) in ascus, irregularly biserial, ellipsoid-fusiform to cylindric-fusiform, colorless, simple or usually with 1 distinct median transverse septum, 12–18 $\times$ 4–5 μ .

Pycnidia immersed, with slightly indented ostiole, globose or subpyriform, 240–500 μ diam., with colorless, finely pseudoparenchymatic wall 5–10 μ thick, convoluted internally so as to form several intercommunicating chambers. Cortical tissue of thallus aeruginose-blackish around the ostiole. Pycnoconidia borne apically on crowded subulate conidiophores, shortly filiform, usually slightly bent, 6–7 $\times$ about 0.5 μ .

The original material of "*Lecidea bumamma*" Nyl. from the Cape of Good Hope has not been examined, but Nylander's short diagnosis describes the peculiar characters of the species so well that it can without hesitation be regarded as identical with Stirton's plant, following Stizenberger, *Lichenea Africana* (1890–91) p. 162. Zahlbruckner, in Engler's *Bot. Jahrb.* LX (1926) p. 495, gives a detailed description of *T. bumamma*, based on a specimen from South Africa, Matjesfontein in the Great Karroo, which agrees closely with Stirton's material. He describes the squamules as 3–5 mm. diam. and the apothecia as finally reaching a size of nearly 2 mm.; the only notable discrepancies are in the color of the epithecium ("umbrino-nigricans") and the size of the conidia ("9–12 μ longa et 1,5–1,7 μ lata"). In *Ann. Cryptog. Exot.* V (1932) p. 240 he describes the species a second time, from a specimen collected by Slabbert at Jansenville, South Africa. This description also shows good agreement with the type of "*Lecidea styloumena*", except that the paraphyses are said to be up to 4 μ thick.

T. bumamma is a terricolous species occurring on soil in crevices of rocks, apparently in rather arid positions. The plant at first sight makes the impression of a parasymbiotic *Scutula* on an alien thallus, on account of the appearance of the closely adpressed, immarginate apothecia and their gelatinously concrete paraphyses. But a careful microscopic examination seems to indicate that the apothecia belong to the lichen, and especially the aeruginose coloration of the thallus cortex in places where apothecia are about to develop confirms this view. Also the finding of similar fertile material in several different localities of South Africa suggests that the apothecia are the natural fruiting bodies of the lichen.

Toninia squalida (Schleich. apud Ach.) Mass. Ricerch. Auton. Lich. Crost. (1852) p. 108. Syn. *Lecidea squalidu*

Schleich. apud Ach., Lichenogr. Univ. (1810) p. 169. *Lecidea atrorufa* var. *squarrosa* Ach. in Kgl. Vetensk.-Akad. Nya Handl. XXIX (1808) p. 267. *Toninia squarrosa* Th. Fr., Lichenogr. Scand. I (1874) p. 331.

T. squalida, f. **caulescens** (Anzi) M. Lamb (n. comb.). Syn. *Toninia caulescens* Anzi, Cat. Lich. Prov. Sondr. (1860) p. 67. *Lecidea caulescens* Tuck., Gen. Lich. (1872) p. 182. *Lecidea squalida* var. *caulescens* Nyl. apud Stizenb. in Jahresber. St. Gallisch. Naturw. Ges. 1880-1881 (1882) p. 430. *Toninia squalida* subsp. *caulescens* Boist., Nouv. Flore Lich., Part 2 (1902) p. 105.

MATERIAL EXAMINED: the authentic, possibly isotype, material from Italy, alps of Bormio and Valle Tellina, in Anzi, Lich. Rar. Langob. no. 139 (Farlow Herb.); Switzerland, Wallis (Körber, Lich. Sel. German. no. 372, Farlow Herb.); Tirol, Windischmatri (Arnold, Lich. Exs. no. 672, herb. Arnold, München); U.S.A., California, no exact locality stated, coll. Bolander, 1871, no. 407, in herb. Tuckerman, Farlow Herb. The following description of this form of *T. squalida* is based on all four specimens cited, individual discrepancies being mentioned.

Squamules gray to reddish-brown, turgid and plicate, $\pm$ imbricated, 0.5-1.5 mm. diam., conrescent into an effuse, $\pm$ continuous crust. Radicate stipes well developed, buried in the earthy substratum, pale, ecorticate, up to 8 mm. long. Thallus externally and internally PD -. Apothecia usually numerous, scattered or crowded and confluent, entirely black, matt (or subnitid where rubbed), 0.5-0.9 mm. diam., at first plane with slightly prominent proper margin, then becoming $\pm$ convex and immarginate, often subdividing into smaller secondary apothecia.

Squamules corticate above and on sides, in many places covered by a hyaline, necrotic, structureless layer up to 10 μ thick. Cortex of variable thickness, 15-100 μ , either entirely colorless and clear or in places dark brown in outer 7-15 μ (there composed of cells 3-5 μ diam. with distinct, thin, pigmented walls), the pale part composed of gelatinized and conglutinated, confluent, thick-walled hyphae in $\pm$ vertical palisade-formation, the cell-lumina distinct, often slightly moniliform, 2-4 μ wide, embedded in a clear gelatinous matrix. Algal stratum interrupted or continuous, 35-110 μ deep; algae cystococcoid, $\pm$ globose, 6.5-10.0 μ diam. Medulla $\pm$ colorless, hyaline or grayish-cloudy, of thin-walled hyphae 2.0-4.5 μ thick somewhat loosely interwoven in various directions. Radicate stipes ecorticate, without algae, composed of indistinct, conglutinated and compacted, $\pm$ thin-walled hyphae 2-3 μ thick running mainly $\pm$ longitudinally in central part, at the periphery more intertexted in various directions; the tissue $\pm$ colorless, not nubilated. In Arnold, Lich. Exs. no. 672, colonies of blue-green algae (chiefly *Stigonema*) are present on the outer surface of the stipes, and on the under side of the squamules some of them are included inside the fungal tissue, and seem to be forming primitive cephalodia.

Excipulum developed at sides, also continued vaguely for some distance below apothecium; 65–100 μ thick, dark purple-brown or brown-blackish from heavy pigment between the hyphae, which are flabellate-radiating (in Arn. Lich. Exs. 672 pigmented only in outermost 4–8 μ). No myelohyphic stratum (central cone tissue) usually present; in Arn. Lich. Exs. 672 the lower hypothecium is looser in texture, with somewhat larger hyphae, and may be referable to central cone. Hypothecium colorless or faintly sordid isabelline, up to about 230 μ deep or produced indeterminately downwards into the

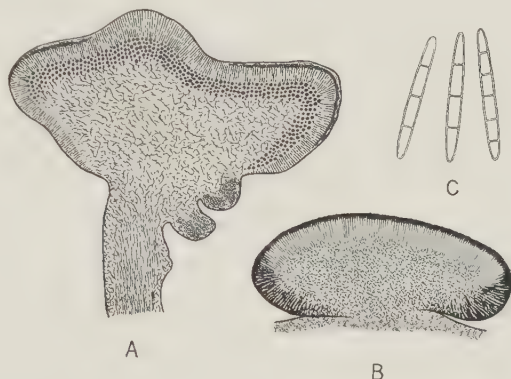


FIG. 10. *Toninia squalida* f. *caulescens* (Anzi) M. Lamb. A, vertical section of a stipate squamule, showing enclosed Cyanophyceous algae, in Arnold, Lich. Exs. no. 672 in Farlow Herb. B, vertical section of apothecium in Anzi, Lich. Rar. Langob. no. 139 in Farlow Herb. C, spores in Anzi, Lich. Rar. Langob. no. 139 in Farlow Herb.

stipe (in Bolander's California specimen with yellowish-gray, cloudy granules in upper part). Hymenium 55–70 μ high, gradually densely aeruginose-blackish in upper 10–17 μ , otherwise colorless and hyaline. Paraphyses $\pm$ discrete in water, 1.5–2.5 μ thick, simple or sparingly branched, not articulated, clavate-capitate to 4 (–5) μ at the $\pm$ densely aeruginose and more conglutinated tips. Asci 45–60 $\times$ 10–13 μ . Spores 6–8 in ascus, fusiform or cylindric-fusiform, straight, rounded or bluntly pointed at ends, 3–5-septate (up to 7-septate in Bolander's California specimen), 24–37 $\times$ 3–4 μ (in Arn. Lich. Exs. 672 somewhat longer and narrower, 30–40 $\times$ 3 μ). Hymenium I + blue then wine-red. Excipulum and epithecium KHO – , HNO₃ + dark violet then violet-purple.

As Vainio (25, p. 131) and earlier authors have pointed out, *Toninia caulescens* is not specifically separable from *T. squalida*. They have exactly the same characters except for the well developed rooting stipes in the former. Stipes are developed to a lesser extent in typical *T. squalida*, as in e.g. Schaerer, Lich. Helv. Exs. no. 170, and *caulescens* can at best be distinguished only as a forma of that species.

Of three North American specimens determined by Tuckerman as "*Lecidea caulescens*" in his herbarium, only one belongs to *Toninia squalida* f. *caulescens*. The other two represent the related species *T. ruginosa* Tuck. Herre's Californian records of "*Toninia caulescens*" in Proc. Wash. Acad.

Sci. XII (1910) p. 102 also refer to *T. ruginosa*.

Toninia ruginosa (Tuck.) Herre in Proc. Wash. Acad. Sci. XII (1910) p. 103. Syn. *Lecidea ruginosa* Tuck., Lichens of California, Oregon and the Rocky Mountains (1866) p. 25; Synops. N. Amer. Lich. II (1888) p. 64.

MATERIAL EXAMINED: the type-specimen from California, Oakland Hills, coll. Bolander, no date, no. 102, in herb. Tuckerman (Farlow Herb.); California, San Mateo Co., near Point San Pedro, coll. A. W. Herre, 1904, in herb. Herre, Olympia, Wash., and Farlow Herb. The type-material, Bolander no. 102, is in two packets, one containing a specimen growing directly on a serpentine stone, the other containing two mounts of the same plant on stone-fragments covered with some detritus. Both are marked with the same collecting number, 102. The following description is made from one of the mounts in the latter packet, this specimen being chosen as the lectotype.

Thallus effuse, consisting of squamules attached either directly to the stone or to detritus over the latter; no dark hypothallus developed. Squamules reddish-brown, matt, (0.3-) 0.5-2.0 mm. diam., turgid and plicate, conrescent into a $\pm$ continuous crust; no radicate stipes developed, but the arachnoid whitish medullary tissue from the under side of the squamules penetrates for some distance into the earthy detritus. Medulla PD -. Apothecia scattered, sessile on the squamules, 0.8-1.5 (-2.0) mm. diam., persistently plane and scutelliform, round or finally $\pm$ flexuose, with thin to moderate, persistent, $\pm$ prominent, black, matt or $\pm$ nitid proper margin and reddish-black to black, naked, matt disc.

Squamules corticate on upper side; cortex well developed, 65-85 μ thick, faintly yellowish (isabelline) in section, clear and transparent, composed of completely conglutinated and gelatinized hyphae intricated in various directions or predominantly $\pm$ vertical, only the lumina (1-2 μ wide) visible in the clear gelatinous matrix. Cortex in most places covered with an outer, colorless, hyaline, gelatinous, amorphous or horizontally striated necrotic layer up to 17 μ thick. Algal stratum directly below the cortex, continuous, 65-100 μ deep, becoming sparse downwards; algae cystococcoid, globose, thin-walled, 6-10 μ diam. Medulla loose, almost arachnoid, clear and colorless or in places $\pm$ yellow-gray-cloudy, hyphose, of fine, thin-walled hyphae about 2 μ thick laxly entangled in various directions. This loose web of medullary hyphae runs down into the substratum for some distance.

Excipulum entire, continuous below apothecium, 100-135 μ thick at sides, 50-60 μ thick below, in outer third to half densely dark reddish-purple from

heavy pigment on and between the hyphae, in inner part gradually faint reddish-purple to $\pm$ clear and colorless; of $\pm$ distinct radiating structure, composed of $\pm$ parallel, conglutinated, gelatinized, thick-walled hyphae, of which only the tubular lumina are visible, 1–2 μ wide; at the sides with wider and shorter lumina (up to 3 μ wide) and becoming indistinctly cellulose. The inner part of the excipulum grades without distinct limit into the hypothecium. Hypothecium 170–200 μ deep, consisting of two parts: (a) a lower, colorless to faintly isabelline, clear and transparent 135–155 μ (perhaps stratum myelohypicum or central cone tissue), composed of completely fused and gelatinized hyphae, only their thread-like lumina (about 1 μ wide) visible, intertexted in various directions in the clear gelatinous matrix; and (b) an upper, sordid yellow-brownish, cloudy but hardly pigmented 50–60 μ of indistinctly cellulose structure, with cell-lumina about 3 μ diam., reaching up to the base of the hymenium. Hymenium 60–70 μ high, gradually dense purple-red-blackish in uppermost 10–17 μ , otherwise colorless and hyaline. Paraphyses discrete, simple or sparingly branched, about 1.5 μ thick, not articulated, at the tips capitate to 3–5 μ and there $\pm$ purplish-pigmented. Asci clavate, 45–58 $\times$ 10–12 μ , with wall 1.0–1.3 μ thick at sides, at apex spuriously thickened to 10 μ . Spores 6–8 in ascus, packed parallel in a bundle; acicular-fusiform, commonly rounded at one end and gradually tapered at the other, straight or rarely slightly curved, 3-septate, 34–47 $\times$ 2.0–2.5 μ (according to Tuckerman, 25–40 $\times$ 2–3 μ , sometimes with more than 3 septa). Hymenium I + blue then sordid olive-brownish. Epithecium and outer excipulum KHO + reddish-purple.

(No pyrenoconidia seen; according to Tuckerman in Synops. N. Amer. Lich. II (1888) p. 65, they are filiform and curved.)

The Californian specimen collected by Herre and recorded as *T. caulescens* differs only slightly from the type-material described above. It is sparingly radicate-stipitate, the stipes being inconspicuous, developed only in places, and $\pm$ ecorticate; most of the squamules, as in Tuckerman's material, are directly sessile on the substratum. The surface of the squamules is slightly nitid. The lower hypothecium is partially purplish or yellow-brownish, and the upper hypothecium is darker, reddish-brown. The hymenium is higher (75–90 μ) and the spores slightly broader (3.0–3.5 μ). These differences appear to come within the limits of normal specific variability.

The distributional area of this species, which differs from *T. squalida* chiefly in its purple-blackish (not aeruginose) epithecium, is interesting. The typical state and the f. *nigricans* described below constitute a Pacific North American element with an area extending from California to Washington; the var. *andicola*, here described for the first time, was found in the high mountains of the preandine Cordillera of prov. Catamarca in N. W. Argentina. This is an unusual type of bicentric

distribution, which seems to be without exact parallel in the flowering plants. There are a number of species common to N. W. Argentina and the highlands of Mexico, but the occurrence of a species of the N. American Pacific coast in the high "puna" region of S. America is surprising and not easily explained. The characters of var. *andicola* do not appear to justify specific separation from *T. ruginosa*.

T. ruginosa, f. nigricans M. Lamb (n. f.)

MATERIAL EXAMINED: the type-specimen from U.S.A., California, exact locality not stated, coll. 1866, *Bolander, 112*, in herb. Tuckerman (Farlow Herb.); Washington, Cascade Mountains, coll. 1883, *Brandegee, 25*, in herb. Tuckerman (Farlow Herb.).

Thallo obscuriore (obscure fuscescens vel fusconigrescens) et apotheciis immarginato-convexis a specie typica differt.

Description of the type-specimen (Bolander 112):—On earthy detritus. Thallus effuse, of conrescent, turgid, plicate squamules similar to those of the typical species, but darker (dark brown to brown-blackish), matt or subnitid. Irregular radicate stipes are developed here and there from the underside of the squamules; they are pale, ecorticate, thin, root-like and branched, buried in the substratum. Medulla PD —. Apothecia numerous, sessile on the squamules, separate or crowded, entirely black, 1.0–1.5 (–2.0) mm. diam., matt (or nitid where rubbed), round, at first plane with thin, entire, non-prominent proper margin, then soon strongly convex and im-marginate.

Excipulum developed at sides and below apothecium, 65–85 μ thick, pale to dark purple-brown in section or $\pm$ colorless in inner part, of flabellate-radiate structure with the hyphae divided into distinct cells 5–7 μ long and 3–5 μ wide. Lower part of hypothecium (probably = central cone or myelohyphic stratum) yellowish-gray-cloudy, compact to $\pm$ lax, formed of distinct, separate, thin-walled hyphae 3.0–3.5 μ thick interwoven in various directions (not gelatinously fused); upper part of hypothecium (= true hypothecium) 100–120 μ deep, varying in the same section from sordid isabelline to yellow-brownish or purplish-brown. Hymenium 55–65 μ high, gradually dark brownish-purple in upper 10–14 μ , otherwise colorless and hyaline. Paraphyses discrete, 1.0–1.8 μ thick, clavate-capitate to 3–4 μ at tips. Asci 45–50 μ long. Spores 6–8 in ascus, elongate-fusiform, straight or slightly curved, bluntly pointed at ends, sometimes gradually tapered towards one end, 5–7-septate, the septa distinct; 27–45 (–50) $\times$ 2.5–3.0 μ . Hymenium I + blue then sordid olive-brown. Outer excipulum, epithecium, and more colored parts of hypothecium KHO + reddish-purple.

The specimen from Washington agrees closely with the type. The hyphae of its lower hypothecium or central cone tissue are more gelatinously confluent, as in the type-specimen of *T. ruginosa*; its spores are 3–5-septate, 30–42 $\times$ 3 μ .

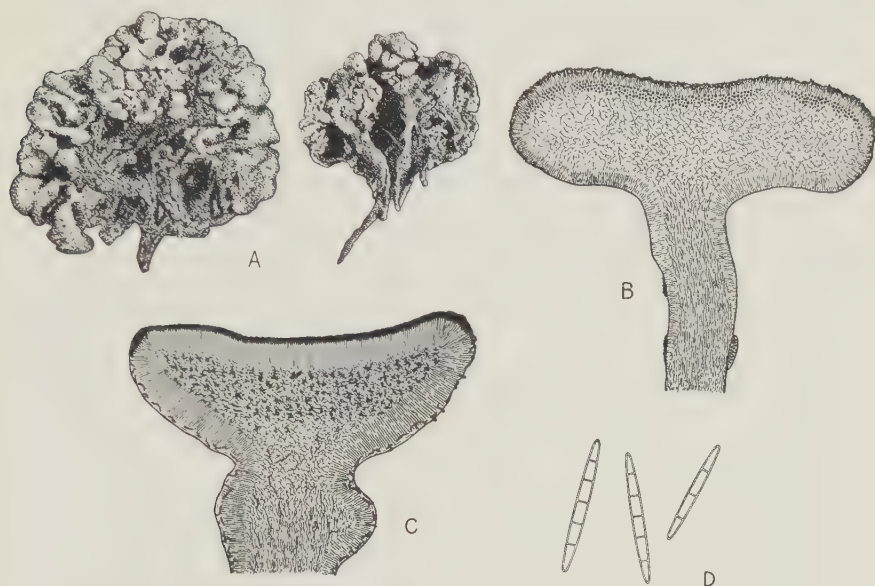


FIG. 11. *Toninia ruginosa* var. *andicola* M. Lamb. The type-specimen. A, parts of thallus showing radicate stipes ($\times 2\frac{1}{2}$). B, vertical section of a stipate squamule. C, vertical section of an apothecium (the dark masses in the hypothecium are included air). D, spores.

***T. ruginosa*, var. *andicola* M. Lamb (n. var.)**

MATERIAL EXAMINED: the type-specimen from N. W. Argentina, Prov. Catamarca, Nevados de Anconquija, Quebrada de los Cazadores, altit. circ. 4500 m.s.m., in the puna-formation, on soil in crevices of a metamorphic rock face, not abundant, coll. 24. Nov. 1948, *I. M. Lamb*, 5599, in Herb. Nat. Mus. Canada, Ottawa, and isotype in Farlow Herb.

Squamulae clavato-bullatae, etiam latere inferiore corticatae, deorsum caulibus bene evolutis et partim corticatis munitae; ceteris notis ut in specie typica.

Description of the type-specimen:—Thallus effuse, in small patches; squamules crowded, turgid-inflated, 0.8–2.0 (–3.0) mm. diam., reddish-brown to dark brown (on lower side paler, yellowish-brown), matt, clavate-bullate, prolonged downwards into corticate, terete or irregularly rugose stipes 0.3–1.0 mm. thick which penetrate the substratum and continue downwards as brownish, root-like, ecorticate strands. Medulla PD –, I –. Apothecia scarce, sessile on the squamules, round or irregular, 1–2 mm. diam., entirely black, persistently plane or scutelliform, with slightly prominent, entire or $\pm$ flexuose, moderate, matt or subnitid proper margin and matt, naked disc.

Cortex of squamules 35–50 μ thick, clear and colorless or faintly yellowish in section, in most places with brown torulose hyphae (parasite ?) on its outer surface; of $\pm$ distinct palisade structure, composed of fused and gelatinized, thick-walled, $\pm$ perpendicularly parallel hyphae, of which only the fistulose lumina are visible, 1.0–1.5 (–2.0) μ wide. Algal stratum irregular, interrupted, up to 100 μ deep. Algae cystococcoid, bright green, globose, thin-walled, 7–14 μ diam. Medulla lax, $\pm$ arachnoid, composed of colorless, thin-walled hyphae about 3 μ thick loosely interwoven in various directions. The cortex is continued for a long way down the sides of the stipes, which are devoid of algae, except for accidentally adherent external colonies of various Cyanophyceae, which are not enclosed in the fungal tissue. Central part of stipes composed of $\pm$ compact, mainly longitudinally-running, colorless or faintly yellow-gray-cloudy, thin-walled hyphae 3–4 μ thick, obviously derived from the medulla.

The apothecial margin is an amphithecium continuous with the cortex of the thallus; 110–150 μ thick, entirely colorless and hyaline or yellow-brownish to purplish-brown in outermost 17–27 μ , composed of parallel-flabellate, fused and gelatinized hyphae of which only the tubular lumina are visible, 1–2 μ wide. Hypothecium 200–220 μ deep in center, colorless and hyaline, but with scattered dark masses of included air, mostly compact in texture, of conglutinated gelatinous hyphae 1.5–3.0 μ thick intricately in various directions. Hymenium 70–90 μ high, $\pm$ gradually reddish-purple-blackish in upper 13–27 μ , otherwise colorless or faintly purple-brownish. Paraphyses $\pm$ discrete in water, simple or sometimes branched, 2–3 μ thick, not articulated, towards the tips gradually purple-brown and there slightly to moderately thickened (up to 3.5–4.5 μ). Asci clavate, 55–68 $\times$ 10–14 μ , with wall 1.0–1.5 μ thick at sides, at apex thickened to 9–10 μ . Spores 4–6 (–8) in ascus, packed straight and parallel; elongate-fusiform, straight, bluntly tapered at ends, 3–5-septate, 30–40 (–50) $\times$ 3–4 μ . Hymenium I + blue to greenish then sordid wine-red. Epithecium KHO + reddish-purple, in HNO₃ unchanged or clearer reddish.

Apart from the morphological differences mentioned in the diagnosis, this specimen differs from the typical *T. ruginosa* in some microscopic characters, which are probably variable and non-taxonomic: the lesser pigmentation of the outer part of the apothecial margin, the quite colorless upper hypothecium, and the thicker paraphyses.

T. ruginosa may be related to the Australian *T. nitida* (Müll. Arg.) Zahlbr. and the Valdivian *T. badia* Räs.; the former differs in its impressed-punctulate squamules and larger spores, the latter in its much larger apothecia and aeruginose-brownish epithecium.

SPHAEROPHOROPSIS Vain.

Sphaerophoropsis stereocauloides Vain., Etud. Lich. Brésil, part 2 (1890) p. 7.

MATERIAL EXAMINED: the (lecto-) type-specimen from Brazil, Minas Geraes, Carassa, coll. 1885, *Vainio*, Lich. Brasil. Exs.



FIG. 12. *Sphaerophoropsis stereocauloides* Vain. Type-material in herb. Vainio. A, portions of plant showing habitus (on left part of the lectotype-specimen, Lich. Brasil. Exs. no. 1475; on right part of Lich. Brasil. Exs. no. 1462) ($\times 3$). B, longitudinal section of part of pseudopodetium in the lectotype-specimen. C, vertical section of apothecium in the lectotype-specimen. D, spores in the lectotype-specimen.

no. 1475, no. 12603 in herb. Vainio, Turku (Åbo); same locality, collector and date, Lich. Brasil. Exs. no. 1462, no. 12602 in herb. Vainio. Vainio mentioned six numbers in the original description, all from the same locality, without designating a holotype. The specimen of Lich. Brasil. Exs. no. 1475 in his herbarium has been chosen as the lectotype, and the following description is based upon it.

On sandy humus. No primary thallus developed; the pseudopodetia are directly attached to the substratum, not expanded at the base, and penetrate into it for a short distance only, appearing to die off at their immersed bases. They are upright, stipitate-caespitose, simple or sparingly branched $\pm$ dichotomously, cylindric-dactylaeform, terete, rounded at the apex, the surface smooth and appearing as if corticate, cream-colored, cinereous-whitish, or pallid ochraceous, matt, not pruinose. The pseudopodetia are minute, 0.5–1.5 mm. long, 0.1–0.3 mm. thick. Where broken across, they are seen to be solid and light-colored internally. Apothecia developed somewhat sparingly on the surface of the tufts and terminal on the stipes; black to brown-blackish, $\pm$ nitid, smooth, not pruinose, convex and immarginate from the first, finally pulvinate and sometimes dividing into two imperfectly separated convex discs. At maturity they are 0.3–0.6 mm. diam. Careful search under the binocular microscope failed to reveal any cephalodia. Pseu-

dopodetia externally PD —, internally PD — or in places + light persistent yellow.

The pseudopodetia are of simple, primitive, undifferentiated structure, homogeneous, without cortical layer and without any central strand of mechanical or conducting tissue. They are composed throughout of closely interwoven, very thick-walled, gelatinous but distinct, colorless hyphae $6.5\text{--}9.5\ \mu$ thick running at random in various directions. A few small interstices are present here and there between the hyphae, but the structure is essentially compact. No nubilating granules or inclusions in section. On the outer side of the stipes the hyphae become somewhat compressed and gelatinously degenerated. Symbiotic algae very irregularly distributed in the pseudopodetia, not forming any continuous stratum, occurring in scattered groups buried in the tissue to a depth of $200\ \mu$ from the surface, in places emerging almost to the surface itself. Algae cystococcoid, pale green, globose, $6\text{--}10\ \mu$ diam., with colorless thin wall.

The excipulum is a sterilized lateral extension of the hymenium, and grades into the latter without sharp limit; it is reflexed to the under side, $75\text{--}100\ \mu$ thick, in section faintly brownish, sordid isabelline, or almost colorless (depending on the thickness of the section), not nubilated, composed of flabellate-radiating, gelatinized and conglutinated, thick-walled hyphae, only their fistulose lumina visible, about $1\ \mu$ wide, $3\ \mu$ apart. No amphithecium present. No clear distinction between mycelohyphic stratum (central cone) and hypothecium; the whole interior of the apothecium, right up to the base of the hymenium (a depth of about $500\ \mu$) is filled with a homogeneous, compact, pallid brownish to almost colorless, clear, gelatinized tissue, *i.e.* the hypothecium, consisting of completely fused hyphae with only the thread-like lumina visible, these about $1\ \mu$ wide and intricated in various directions. Scattered spots and patches of a brownish pigment are present in the upper part of the hypothecium, but there are no granular inclusions. In the upper subhymenial $70\text{--}100\ \mu$ the hyphae become more predominantly vertical, and between them are some cells with wider, $\pm$ isodiametric or vertically oblong lumina up to $5\ \mu$ diam. (remains of carpogonia?). Hymenium about $70\ \mu$ high, rather ill-delimited from the hypothecium, unevenly pallid brownish in section, with vertical streaks of reddish-brown pigment extending through its whole depth; in uppermost $6\text{--}9\ \mu$ more intensely reddish-brown, and covered on the surface by a structureless, colorless, gelatinous layer $3\text{--}5\ \mu$ thick. Paraphyses not numerous, conglutinated and only with difficulty separable in water, about $1.5\ \mu$ thick, vaguely and effusely $\pm$ brownish-pigmented towards their tips, which are not noticeably thickened. Asci numerous, clavate, $50\text{--}68 \times 10\text{--}14\ \mu$, with wall about $1\ \mu$ thick at sides, gelatinously thickened up to $10\ \mu$ at the apex. Spores 8 and subbiseriate in ascus, colorless, ellipsoid to ellipsoid-fusiform, soon transversely 1-septate, the walls and septum thin and equal (about $1\ \mu$); $12.0\text{--}13.5 \times 4.5\text{--}5.5\ \mu$. Hymenium and upper part of hypothecium persistently blue with Iodine.

The other specimen examined, no. 1462, is very similar, but the apothecia are more numerous, and often laterally sessile near the ends of the stipes. The latter are finally sparingly branched, up to 6 mm. long, externally and internally KHO —, internally PD + persistent light yellow. Internal anatomy of apothecia similar to that of the lectotype; the hypothecial tissue however is more colored with unevenly dispersed reddish-brown pigment, more densely in the upper $100\text{--}170\ \mu$. Hymenium somewhat lower ($50\text{--}60\ \mu$), unevenly dark brown in the upper $5\text{--}8\ \mu$ below the gelatinous covering layer. Asci $44\text{--}57\ \mu$ long. Spores 1-septate, seen only inside the ascus, about $10 \times 4\ \mu$.

Reinke (17, pp. 98–99) has described and figured this species, and his observations are quite accurate. However, the pseudopodetia are more closely crowded together than is shown in his fig. 35 (reproduced also in Zahlbruckner's treatment in Engler and Prantl, Nat. Pflanzenfam., VIII, 1926, p. 195), and the apothecia are usually terminal. As Reinke points out, the form of the thallus approaches that of *Toninia*, but it differs anatomically from the latter in its undifferentiated structure and lack of cortex. The holostelidious pseudopodetia, with the symbiotic algae buried in the tissue and not forming leprose or granulate excrescences on the surface, distinguish *Sphaerophoropsis* from *Catillaria* sect. *Hypocaulon* M. Lamb, in which the pseudopodetia are enteropodious in origin. The apothecial structure is similar to that of many species of *Catillaria* and *Eacidia*, so that the inclusion of *Sphaerophoropsis* in the *Lecideaceae*, near *Toninia* and *Catillaria*, seems quite correct. It probably represents a primitive isolated side-branch of the ancestral Catillario-Bacidoid stock.

Sphaerophoropsis stereocauloides has been recorded by Räsänen (16, p. 58) from Tierra del Fuego, on sterile material. The specimen has not been seen by the present author.

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SUMMARY

The development of upright orthotropic stipes below the apothecia in inoperculate Discomycetous fungi is found in non-lichenized as well as in lichenized groups. Of the former, the Geoglossaceae (Helotiales) are the best examples, and in these the stipe represents an extension of the apothecial tissues. In the latter, the development of stipes below the apothecia may be due to the elongation of either apothecial tissues (true podetia) or thalline tissues (pseudopodetia). True podetia may become secondarily clothed by thalline tissue containing algae and thereby converted into assimilative organs. Fruticose development in the lichenized Discomycetes is characteristic of the families Cladoniaceae

and Stereocaulaceae, both of which are obviously derived from prototypes corresponding to members of the family Lecideaceae. In the Lecideaceae there are at the present day some forms showing this tendency to a greater or less extent, in the form of either true podetia or pseudopodetia. Detailed descriptions of such forms are here given in order to elucidate the probable phylogenetic origins of some of the more highly evolved fruticulose genera belonging to the families Cladoniaceae and Stereocaulaceae.

Descriptions of the following species are given:—*Bacidia* (*Eubacidia*) *buchanani* (Stirt.) Hellb.; *Bacidia* (*Eubacidia*) *robinsonii* (Vain.) M. Lamb; *Bacidia* (*Weitenwebera*) *gomphillacea* (Nyl.) Zahlbr.; *Bacidia* (*Thamnopsis*) *fibrosa* M. Lamb; *Bacidia* (*Thamnopsis*) *stipata* M. Lamb; *Catillaria* (*Biatorina*) *columnatula* (Nyl.) Zahlbr.; *Catillaria* (*Hypocaulon*) *corymbosa* (Hue) M. Lamb; *Sphaerophoropsis* *stereocauloides* Vain.; *Toninia* *bumamma* (Nyl.) Zahlbr.; *Toninia* *conglomerata* (Ach.) Boist.; *Toninia* *ruginosa* (Tuck.) Herre (with f. *nigricans* M. Lamb and var. *andicola* M. Lamb); *Toninia* *squalida* (Schleich. apud Ach.) Mass. (f. *caulescens* (Anzi) M. Lamb). NEW SECTIONS:—*Bacidia* sect. *Thamnopsis* M. Lamb; *Catillaria* sect. *Hypocaulon* M. Lamb. NEW SPECIES: *Bacidia* (*Thamnopsis*) *stipata* M. Lamb. NEW VARIETY: *Toninia* *ruginosa* var. *andicola* M. Lamb. NEW FORM:—*Toninia* *ruginosa* f. *nigricans* M. Lamb. NEW NAME: *Bacidia* (*Thamnopsis*) *fibrosa* M. Lamb (Syn. *Stereocaulon* *laseroni* Dodge, non *Bacidia* *laseroni* Dodge). NEW COMBINATIONS:—*Bacidia* (*Eubacidia*) *robinsonii* (Vain.) M. Lamb (Syn. *Toninia* *Robinsonii* Vain.); *Catillaria* (*Hypocaulon*) *corymbosa* (Hue) M. Lamb (Syn. *Alectoria* *corymbosa* Hue); *Toninia* *squalida* f. *caulescens* (Anzi) M. Lamb (Syn. *Toninia* *caulescens* Anzi).

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A NEW SPECIES OF NEUROPOGON FROM
THE UNITED STATESHENRY A. IMSHAUG¹

Neuropogon is a rather small genus of lichens, or, more properly, lichen-forming fungi, which is closely related to the genus *Usnea*. Motyka (1936) in his monograph of the latter genus included *Neuropogon* as a subgenus. In addition to the monograph by Motyka, *Neuropogon* has been studied monographically by Lamb (1939 and 1948). Motyka (1936) recognized twelve species while Lamb (1948) recognized eleven (or possibly twelve) species. As a result of these studies the genus is better known taxonomically than most genera of lichen-forming fungi.

Considerable interest has centered on this genus because of its distribution. Only one species, *Neuropogon sulphureus*, is known from the northern hemisphere; all the other species are known only from the southern hemisphere. Lynge (1941) made an exhaustive study of *Neuropogon sulphureus* and brought together all the information known about this species. Included in this paper were a number of maps showing its distribution. It is a typical bipolar lichen, being found in the arctic, the antarctic and in the high Andes of South America. Its distribution in the northern hemisphere is limited to the arctic islands, and despite long and intensive search by many lichenologists this species has never been found on any of the continents of the northern hemisphere. In the arctic, *Neuropogon sulphureus* is quite monotypic, both morphologically and chemically, as stated by Lamb (1939) and Lynge (1941).

The discovery of a species of this genus on a continent in the northern hemisphere is, therefore, a find of no small importance. The present writer has searched for the genus for a number of years in alpine regions of western America without success. While studying at the Farlow Herbarium,² however, he had the good fortune to meet Dr. P. F. Scholander, who, in the course of conversation, mentioned the fact that he had collected a *Neuro-*

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² I am indebted to the late director of the Farlow Herbarium, Dr. W. L. White, for the many courtesies received while there. I am also indebted to the University of Michigan for the granting of a Horace H. Rackham Postdoctoral Fellowship for the year 1951-1952 which enabled me to spend considerable time at the Farlow Herbarium.

pogon in Mt. Rainier National Park some years previously. The subsequent examination of this material, deposited in the Farlow Herbarium, showed that this was an undescribed species of *Neuropogon*. Dr. I. M. Lamb, to whom a part of the collection was sent, agreed that it was a new species, and said, in a letter, "it comes closest to *N. acromelanus* Stirt., but differs in the laxer medulla and thin central strand, and cannot be included in that species." The new species is similar to *Neuropogon sulphureus* in the lax nature of the medulla, but differs in that the branches are not scabrid-verruculose.

It gives me great pleasure to name this interesting species in honor of one of lichenology's most devoted students and an outstanding monographer, Dr. I. Mackenzie Lamb.

***Neuropogon lambii* Imshaug, sp. nov.**

Thallus parvus (usque ad 2 cm. altus), erectus, basi anguste substrato affixus, sat parce ramosus. Rami basales 0.70–0.85 mm. crassi (infra angustiores), sulphurei, omnino laeves et nudi, subnitidi, haud verruculosi. Ramuli terminales tereti, nigro-variegati, laeves, nitidi, apicibus subcapillaribus fere omnino nigris. Apicem versus rami et praecipue ramuli globoso-sorediati, soralia vulgo 0.2–0.5 mm. lata, ab initio sulphurea, deinde aterrima. Apothecia et pycnidia non visa. Medulla valde laxa, alba; axis tenuis, circ. $1/4$ – $1/3$ diametri ramorum. Reactiones: medulla KOH et Pd non mutatur. Specimen typicum in Herb. Farlow conservatum; legit prope Yakima Park, Mt. Rainier National Park, Washington, U. S. A., *P. F. Scholander*, Aug. 19, 1942.

Thallus erect fruticulose, up to 2 cm. tall, narrowly attached at the base to the substratum, branching sparsely. Basal branches 0.70–0.85 mm. in diam. at widest part but tapering to 0.3–0.4 mm. in diam. at point of attachment. Main branches sulphureous, but occasionally blackening above, subnitidous, smooth, neither foveolate, nor verrucose, nor annular rimose. Ultimate branches 0.1–0.25 mm. in diam. and tapering to a point; blackening so as to frequently produce a banded effect. Soredia yellowish, occasionally blackening, mealy granulose, in soralia 0.2–0.5 mm. across. Soralia rather abundant on ultimate branches.

Medulla white, lax, arachnoid; central axis well defined, white, usually rather thin, diameter of axis usually being $1/4$ – $1/3$ that of the branch (but occasionally approaching $1/2$ the diameter of the branch).

Apothecia and pycnidia unknown.

Chemical Reactions: Thallus (central axis, medulla and cortex) Pd — and KOH —.

Type Specimen: Yakima Park, 6000 ft., in Mt. Rainier National Park, Washington, U. S. A. Collected by *P. F. Scholander*, August 19, 1942 and deposited in the Farlow Herbarium, Harvard University. Specimen overgrown with *Alectoria pubescens*.

The occurrence of a lichen with arctic affinities on Mt. Rainier but not at high elevations in the Rocky Mountains is a matter of considerable interest, especially so since this is not the only example. *Buellia moriopsis* (Mass.) Th. Fr.³ was collected by the present writer in Mt. Rainier National Park in 1948. This species, although apparently common in the eastern Canadian Arctic and in the mountains of New England is unknown from the Rocky Mountains.

Torrey (1937) reported the discovery of *Dactylina arctica* on Mt. Rainier by Miss A. Wilson. The specimen was sent to Lynge for verification and since it is not in the herbarium of the New York Botanical Gardens it is presumed to be in Oslo. The taxonomy and distribution of the species now included in the genus *Dactylina* were thoroughly reviewed by Lynge (1933 and 1934). *Dactylina arctica* does not occur in the Rocky Mountains of the United States, although it does occur further north in Alberta. In the last few years the present writer made an intensive search for *D. arctica* in the Rocky Mountains but was unable to discover any localities south of Latitude 51° 24'. This would appear to be the approximate southern limit of its range in the Rocky Mountains.

Another species conspicuously absent from the Rocky Mountains is *Alectoria ochroleuca*. This species is, however, common in alpine regions of Mexico and the Andes.

Similar types of distribution are shown for the Umbilicariaceae by Llano (1950). This apparent absence of certain arctic and bipolar species from the Rocky Mountains is an interesting phytogeographical problem and one on which the present writer has devoted much field work. A detailed discussion of this problem will appear at a later date, after additional field work is completed.

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³ This species is commonly called *B. atrata* (Sm. in Sm. & Sowerb.) Anzi. The basonym of the latter, however, is a later homonym of *Lichen atratus* Hedwig, which is now called *Lecanidion atrata*, a nonlichen-forming discomycetous fungus.

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STUDIES IN THE COMPOSITION AND DISTRIBUTION OF THE OKLAHOMA FLORA—XXI¹

U. T. WATERFALL

CONTINUED investigations of our state's flora have resulted in additional data concerning its composition and distribution. In this paper the taxa not found listed in monographs, floras, checklists, and similar publications as occurring in Oklahoma are prefixed with an asterisk. There are 34 such entities recorded here. Four of them are newly described forms. About one-third of these additions were collected in southeastern Oklahoma, mostly in McCurtain County. The Ozark region in the north-east, and the two or three southwestermost counties each provided about one-fifth of the species listed. The rest came from various parts of the state. Unless otherwise indicated the cited specimens are to be found in the Herbarium of Oklahoma A. & M. College at Stillwater.

BOTRYCHIUM DISSECTUM Spreng., forma *OBLIQUUM* (Muhl.) Fern. is little known in the state. Stemen and Myers in their Flora, p. 17, state that it occurs in McCurtain County. The only material I have seen is *Coryell 715*, edge of pine-oak woods 6 miles southeast of Bethel, McCurtain County, Oct. 22, 1950.

CHEILANTHES WOOTONI Maxon has been reported from the Wichita Mts. of southwestern Oklahoma. We also have it as *F. C. Green*, collected on Hallock's Ranch, Cimarron County.

**ARISTIDA BARBATA* Fourn. is an unbranched perennial with an open panicle having glandular tissue in the axil of each panicle-branch, and with the first glume a little shorter than the second one. It is represented from Cimarron County by the following: *Waterfall 7479*, base of Black Mesa, 4 miles north of Kenton, July 9, 1947; *Waterfall 8634*, ditch 13 miles west of Boise City, Aug. 22, 1948; *Waterfall 9740*, sandstone slopes,

¹ The 20 previous papers in this series have appeared under various titles in the last 14 years. Most of them were published in *RHODORA*.

5 miles south of Kenton, Oct. 7, 1950. It has been known previously from "western Texas to Arizona and central Mexico" according to Chase in the second edition of Hitchcock's Manual.

**ERAGROSTIS GLOMERATA* (Walt.) L. H. Dewey, a rather large annual with a narrow panicle having stiffly ascending branches and small spikelets 2-3 mm. long, is represented by *Chaffin*, Coal County, Sept. 9, 1949. In Hitchcock's Manual the range is given for as far west as "Missouri and eastern Texas."

**ERIANTHUS GIGANTEUS* (Walt.) Muhl. has a relatively broad inflorescence (mostly 2.5 to 3 times as long as wide) with copious brownish hairs at the bases of the spikelets, these being about twice as long as the spikelets (excluding the awns). The terete awns are neither spirally coiled at their bases, nor strongly divergent in their upper parts. This species was found in McCurtain County and collected as *Waterfall 10417*, oak-hickory-pine woods, 3 miles north of Tom, Oct. 13, 1953. Previously it has been known from as far west as Arkansas and eastern Texas according to Chase in Hitchcock's Manual.

**LEPTOCHLOA UNINERVIA* (Presl) Hitchc. & Chase was collected in water on the north arm of Hickory Creek, Love County, as *Harris*, July 10, 1949. Chase (op. cit.) ascribes this species to both Texas and Louisiana.

**PANICUM AGROSTOIDES* Spreng., var. *RAMOSIUS* (Mohr) Fern., with branches loosely floriferous, was collected as *Waterfall 9799*, edge of *Taxodium* swamp, 3 miles south of Eagletown, McCurtain County, Oct. 21, 1950. Fernald (Gray's Manual, ed. 8) includes Texas and Missouri in the western range of this variety.

**PANICUM REVERCHONI* Vasey. So referred are: *Waterfall 7747*, gypsum hills along Elm Fork of Red River, 3 miles west and 14 south of Erick, Harmon County, June 3, 1948; *Waterfall 7802*, along Red River at base of gypsum escarpment, 4 miles east and 4 south of Eldorado, Jackson County, June 5, 1948. In the second edition of Hitchcock's Manual the species is said to occur only in Texas.

**PASPALUM LAEVE* Michx., var. *PILOSUM* Scribn. (*P. plenipilum* Nash, *P. longipilum* Nash). Referred to this taxon, because the sheaths and blades are strongly pilose, are *Waterfall 9858*, edge of pond in oak-pine woods, 2 miles southeast of Bethel, McCurtain County, Oct. 22, 1950, and *Waterfall 10480*, prairie, 1 mile south of Tom, McCurtain County, Oct. 23, 1950. Fernald (op. cit.) says that this variety extends north to southern Missouri.

**SPHENOPHOLIS FILIFORMIS* (Chapm.) Scribn. So referred is *Waterfall 6916*, in an oak forest on a cherty hillside, 8 miles south of Wyandotte, Ottawa County, June 6, 1947. Fernald (op. cit.) says that it occurs from "Fla. n. to Va. and Tenn."

**CAREX FLACOSPHERMA* Dewey was collected as *Waterfall 9322*, edge of swamp, 7 miles south and 1 east of Idabel, McCurtain County, April 15, 1950. It is somewhat similar to *C. amphibola*, but has a greater number of perigynia in a longer spike, and the pistillate scales are only

about one-third as long as the perigynia. It was previously known (according to Fernald, op. cit.) from as far west as Texas and southeastern Missouri.

**CAREX HALEANA* Olney. So referred are the following because they have small perigynia (1–1.5 mm. wide) and consequently narrower spikes than *C. granularis*. *Waterfall 6900*, along small spring-fed stream in shade of hickories in an elm-ash-sugar maple forest, south of Wyandotte, Ottawa County, June 6, 1947; *Waterfall 10034*, open woods along creek bottom, 10.5 miles west and 3 north of Tahlequah, Cherokee County, June 18, 1951.

**CAREX OXYLEPIS* Torr. & Hook. is represented by *Aven* and *Ruth Nelson* and *George Goodman 5599*, marshy ground along stream, Ouachita Mountains, about 15 miles north of Broken Bow, McCurtain County, April 21, 1946 (ov). It has been recorded previously (Gray's Manual, ed. 8) from as far west as Texas and southeastern Missouri.

CAREX ROSEA* Schkuhr was collected as *Waterfall 9630*, in deep woods along Little River, 3 miles northeast of Idabel, McCurtain County, April 16, 1950. Mackenzie (N. Am. Fl. **18 (1): 45–46) says that specimens were examined from Louisiana, Arkansas and Missouri.

CAREX ROSEA* Schkuhr, var. *TEXENSIS* Torr. The author believes that Torrey's original concept indicates the relationship of this taxon better than separating it as a distinct species as has been done by Bailey (Mem. Torr. Bot. Cl. **5: 97. 1894), or treating it as a variety of *C. retroflexa* as was done by Fernald (RHODORA **8**: 166. 1906). The principal difference between var. *rosea* and var. *texensis* seems to be the serrulate beak and upper part of the perigynium of the latter. We have var. *texensis* as *Waterfall 10691*, wooded bottom along Mountain Fork in Beaver's Bend State Park, 7 miles north and 4 east of Broken Bow, McCurtain County, April 26, 1952; *Robbins 2882*, rich soil in flood plain woods on north bank of Little River, 6.5 miles south of Broken Bow, McCurtain County, April 10, 1945 (ov); *Robbins 2951*, rich moist soil in oak-hickory woods about 0.5 mile southeast of Ada, Pontotoc County, April 28, 1948 (ov).

**CAREX STRIATULA* Michx. So referred is *Little* and *Olmstead 1581*, *Quercus alba* climax forest association, uncut and unburned, southwest part of T4S, R25E, McCurtain County, June 5, 1930 (ov). The fruiting culms are mostly twice as long as the basal leaves, and are not winged.

**CYPERUS POLYSTACHYOS* Rottb., var. *TEXENSIS* (Torr.) Fern. was collected as *Waterfall 11162*, along creek running through woods, 3 miles south of Broken Bow, McCurtain County, Oct. 10, 1952. It somewhat resembles *C. rivularis*, but has linear to linear-oblong achenes about 0.5 mm. wide.

**ELEOCHARIS LANCEOLATA* Fern. with capillary culms, lanceolate-acuminate spikelets and acute scales is represented by *Waterfall 10277*, along creek in open woods, 2 miles east of Braggs, Muskogee County, July 24, 1951 and by *Waterfall 8521*, along creek in wooded hills, 2 miles

north of Broken Bow, McCurtain County, Aug. 9, 1948. It has been known previously² only from Arkansas and Texas.

*TRADESCANTIA OHIENSIS Raf., forma **pilosa** Waterfall, f. nov., vaginis inferioribus pilosis. The TYPE is *Waterfall 10018*, prairie along railroad right-of-way, 2.5 miles south of Braggs, Muskogee County, June 12, 1951. It is in the herbarium of Oklahoma A. & M. College. Isotypes have been distributed to several other herbaria. We have additional material from Pushmataha, Pontotoc, Payne and Cleveland Counties. The lower sheaths are rather abundantly pilose in most of the specimens. In a few the pilosity is somewhat sparse.

*TRADESCANTIA ERNESTIANA Anderson and Woodson, forma **alba** Waterfall, f. nov., petalis albis. The TYPE of the white-flowered form is *Wallis 395* on flint bluff, 3.6 miles northeast of Tahlequah, Cherokee County, May 9, 1951. It is in the herbarium of Oklahoma A. & M. College.

*CHENOPODIUM PUMILIO R. Br. (*C. carinatum* of auths., not R. Br.). We have the following collections: *Waterfall 11204*, along creek running through oak-hickory woods in mountains, 3 miles north of Broken Bow, McCurtain County, Oct. 11, 1952; *Waterfall 11211*, along Little River, Honobia, Pushmataha County, Oct. 12, 1952; *McCoy 3113*, rocky feed lot near Breco Lake, 3 miles south of Ada, Pontotoc County, July 6, 1952.

*LEPIDIDIUM AUSTRINUM Small. So referred are: *Demaree 12567*, Arbuckle Mts. near Turner Falls, Murray County, May 26, 1936; *Elwell 107*, near Guthrie, Logan County, June 15, 1938; *Waterfall 2700*, railroad, 2 miles south and 4 east of Britton, Oklahoma County, May 17, 1941. The fruits are slightly appressed-hairy, and the stems are rather noticeably hirsute. Hitchcock³ reports this species from "central and southwestern Texas and Mexico."

*PSORALEA TENUIFLORA Pursh, forma **ALBA** Steyermark was collected as *Pinson*, prairie 5 miles north of Shawnee, Pottowatomie County, May 13, 1953.

*CENTAUREUM TEXENSE (Griseb.) Fern. was collected in the Wichita Mountains of southwestern Oklahoma as *Waterfall 9129*, limestone slopes, 13 miles west and 3 north of Elgin, Comanche County, July 5, 1949. Tidestrom and Kittell, in their *Flora of Arizona and New Mexico*, state that this species ranges from Texas to southern New Mexico.

*PHACELIA STRICTIFLORA (Engelm. & Gray) Gray, var. **ROBBINSII** Constance, forma **albiflora** Waterfall, f. nov., corollis albis. The TYPE is *Waterfall 11277*, sand in opening in post oak—black jack woods, 7 miles south of Antlers, Pushmataha County, April 17, 1953. It is in the herbarium of Oklahoma A. & M. College. The white-flowered form was rather rare among large numbers of lavender-flowered plants.

*HEDEOMA SANCTA Small. So referred is *Waterfall 9440*, bank of Red River under *Juniperus Pinchoti*, 4 miles east and 4 south of Eldorado,

² SVENSON, H. K. *Monographic Studies in the Genus Eleocharis*. RHODORA 31: 207-208. 1929.

³ HITCHCOCK, C. LEO. *The Genus Lepidium in the United States*. Madrono 3: 287-288. 1936.

Jackson County, May 13, 1950. The calyx tubes are about 5 mm. long, while the subtending ovate leaves are about 1 cm. long. Small, in his "Flora" states that the species occurs "in dry soil, Texas."

**LYCOPUS RUBELLUS* Moench, var. *ARKANSANUS* (Fresn.) Benner was collected as *Waterfall 11176*, growing on cypress knees (*Taxodium*) in dried-up cypress swamp, 3 miles south of Eagletown, McCurtain County, Oct. 10, 1952. Another number, *11183*, was taken from a more conventional habitat, the edge of the swamp, at the same time. The species has been known previously according to Fernald (Gray's Manual) from as far west as Arkansas and northeastern Texas.

**DATURA QUERCIFOLIA* HBK., characterized by the fruit having unequal prickles with the larger ones being 1.5-2 cm. long and much flattened and widened toward their bases, was collected as *Waterfall 9700*. It was collected in sand in the bed of the Cimarron River, one-half mile north of Kenton, Cimarron County, Oct. 6, 1950. It was also observed in several places in the valleys near Kenton. Gray, in the Synoptic Flora (2 (1): 240. 1886), states that it occurs from the southwestern borders of Texas to Arizona, and that it is naturalized from Mexico. Essentially the same information is given by Tidestrom and Kittell in their Flora of Arizona and New Mexico.

**LYCIUM PALLIDUM* Miers. On a trip to the Black Mesa area of Cimarron County in the northwestern end of the Oklahoma panhandle the author found a small stand of a species of *Lycium* in a vegetative state. After seeing it for several years, but never finding it in flower, he dug up a plant, and transplanted it in Stillwater. On May 1, 1952 it flowered and proved to be *L. pallidum*. On May 30, 1952 the original find, "on a stony ridge 6 miles north of Kenton, Cimarron County," was revisited and found in flower. It was collected as *Waterfall 10760*. The corollas are greenish, and the ovaries are on, or surrounded by, red discs. Hitchcock's⁴ statement concerning distribution includes "western Texas, southern Colorado, New Mexico . . ."

**NICOTIANA TRIGONOPHYLLA* Dunal was mentioned earlier by the author in "A list of species of southwestern affinities,"⁵ but has not been otherwise reported from the state. Although he has known the species for several years, the author unintentionally omitted it from his recent enumeration of the Oklahoma Flora.⁶ We have it as *Waterfall 7801*, 4 miles east and 4 south of Eldorado, Jackson County, June 5, 1948. It has been observed several times since along the Red River in this area, but is known nowhere else in the state.

**CASTILLEJA PURPUREA* (Nutt.) Don, forma *corallina* Waterfall, forma nov., bracteis et calyceibus pallido-corallinis. The forma with coral-pink bracts and calyces is occasional in colonies of forma *purpurea* near Hugo

⁴ HITCHCOCK, C. LEO. *A Monographic Study of the Genus Lycium of the Western Hemisphere*. Ann. Mo. Bot. Gard. 19: 299-304. 1932.

⁵ WATERFALL, U. T. *Some Additions to the Oklahoma Flora*. RHODORA 52: 20. 1950.

⁶ WATERFALL, U. T. *A Catalogue of the Flora of Oklahoma*. 1-91. 1952. Publ. Research Found., Okla. A. & M. College, Stillwater.

and Ft. Towson near the type locality of *Euchroma purpurea* Nutt., "on rocks in the hilly prairies of Red River."⁷ The TYPE is *Waterfall 9287*, prairies on "blackland" (shallow limestone-derived soil), 0.5 mile north of the junction of Highways 271 and 70, northwest of Hugo, Choctaw County, April 15, 1950. It is in the herbarium of Oklahoma A. & M. College at Stillwater.

IBERVILLEA LINDHEIMERI (Gray) Greene has been known from the Arbuckle Mts., where it is uncommon, for several years. We have additional material from the following counties of southwestern Oklahoma: *Waterfall 9406*, twining on *Lycium Berlandieri*, gypsum flat, 5.5 miles south of Hollis, Harmon Co., May 13, 1950; *Waterfall 9438*, gypsum bluffs along Red River, 4 miles east and 4 south of Eldorado, Jackson Co., May 13, 1950; *Waterfall 7679*, granite mountainside, north of Granite, July 28, 1947.

**BIDENS ARISTOSA* (Michx.) Britt., var. *MUTICA* (Gray) Gattinger. The variety with awns lacking has been known previously from as far west as Missouri and western Louisiana according to Sherff.⁸ We have it as *Waterfall 9832*, wet spot, 1 mile south of Idabel, McCurtain County, Oct. 21, 1950.

**CENTAUREA SOLSTITIALIS* L. We have this introduced species as *Engleman 510*, in irrigated pasture of Elmo Jones near Goodwell, Texas County, July 20, 1953; also we have a specimen "collected by a farmer" near Sapulpa, Creek County, July 15, 1947.

**CIRSIIUM VULGARE* (Savi) Tenore (*C. lanceolatum* of auths., not Hill) was collected as *Waterfall 7581*, edge of swamp, 8 miles south and 3 east of Idabel, McCurtain County, July 18, 1947, and as *Wallis 879*, roadside ditch, 3.8 miles south of Tahlequah and 5.2 miles southeast, Cherokee County, Aug. 6, 1951.

**COREOPSIS GRANDIFLORA* Hogg., var. *LONGIPES* (Hook.) T. & G. Referred here is *Waterfall 9451*, northern slopes of granite mountains, south of Lake Altus, Kiowa County, May 14, 1950. The collection has long peduncles (up to 30 cm. long) as Sherff⁹ describes var. *longipes*. The flowering heads (including the rays) are 5-7 cm. across; the rays are 2-3 cm. long. Sherff cites material from Texas only.

**LIATRIS PUNCTATA* Hook., forma *ALBA* Horr & McGregor. This white-flowered form was collected by Beck and Patterson in a prairie, 3 miles north of Stillwater, Payne County, Oct. 2, 1951.—DEPARTMENT OF BOTANY AND THE RESEARCH FOUNDATION, OKLAHOMA A. & M. COLLEGE, STILLWATER.

⁷ Trans. Am. Phil. Soc. 5 (n.s.): 180-181. 1837.

⁸ Field Museum of Nat. Hist.—Botany 16: 214-217. 1937.

⁹ Field Mus. Nat. Hist.—Botany 11: 354. 1936.

WILLIAM ARRENTS SILVEUS.—William Arrents Silveus was born in Greene County, Pennsylvania, November 6, 1875, and died August 16, 1953, in San Antonio, Texas. Son of David Moredock and Euphen May (Ely) Silveus, he was graduated from Waynesburg College in 1901 with the degree of Bachelor of Arts. In 1906 he was graduated from the University of Texas Law School and began the practice of law in San Antonio. He early took an interest in real estate and by the time he had reached his early fifties he was in a position to retire from active business with a comfortable competence.

For a number of years he had accompanied his wife to Colorado Springs in early summer, returning for her in September, at both of which times it was his custom to spend a few days. Not caring for the usual pastimes of resort vacationers, he spent much of his time in long walks into the surrounding mountains, where, to satisfy the inquisitiveness of a small son, he learned most of the local forest trees. But the thousand miles between San Antonio and Colorado Springs lay almost entirely across grassland, much of which was devoted to grazing. Practice in distinguishing differences between different kinds of trees gave him an eye for differences between component grassland species. Most striking in the fall, they particularly attracted his attention at that season and he became deeply interested in discovering their significance. To that end he bought books on grasses, a binocular microscope, dissecting instruments and other equipment necessary to facilitate his studies. With these, and without any previous botanical training, he set energetically to work, collecting the vast bulk of his own material and working on it in an attic laboratory he built in his home.

As his work progressed his interest grew and grew till it attained an intensity like unto a religious fervor imbued with a missionary spirit. Having found them so engrossingly interesting to himself and being mightily impressed with their vast importance in the economy of meat, wool and mohair production under bad and increasingly worsening range conditions, he literally sold himself on the idea of becoming virtually an apostle of the grasses.

He found to his surprise, when he first aspired to begin his own study, that there was no single treatment of the grasses

of Texas. He found, further, that all treatments were not only scattered but were couched in terms so highly technical that to comprehend them necessitated the acquisition of a practically foreign vocabulary. In overcoming this last handicap, *The First Book of Grasses*, authored by Agnes Chase, and published by Macmillan some years earlier, proved to be of inestimable value.

His goal was to provide all the essential information concerning Texas grasses in one book—information which he would make as easily available as possible to the interested, intelligent and inquisitive layman.

In order thoroughly to familiarize himself firsthand in the field with the subject matter for this proposed book, Mr. Silveus embarked upon a series of field investigations which was to last over a period of several years and take him repeatedly into every section of the state. He had hardly begun this phase of his work before it became apparent that a good photographic record would be essential. Accordingly he purchased for this purpose adequate equipment which he taught himself to use to effective advantage. In order to bring out detail, he devised a lighted box for use in his hotel room at night. Uniform light intensity and a favorable background enabled him to accumulate the excellent photographs from which to make illustrative plates.

In order to emphasize essential details not readily discernible in photographs, he employed a capable artist to whom he painstakingly pointed out such details, supervising the drawings to make sure they reflected the facts. In the matter of details which could be revealed only by dissection, he had her make line drawings from appropriate material which he carefully dissected under a binocular microscope and patiently explained. Cuts of these drawings accompanied appropriate photographic illustrations.

Another unusual feature, calculated to soften the impact of otherwise long and difficult strange words, was the introduction of common diacritical marks as an aid to pronunciation. This he did with the help of a generous and competent friend.

Still another unique feature is an illustrated key to the tribes, in which line drawings suggest the form and appearance both of the inflorescence and the spikelet, not only of a single representative genus, but frequently of two or more genera.

Thus it was that, in 1933, at the age of fifty-eight, this lawyer-turned-agrostologist published, entirely at his own expense, a really remarkable book: *Texas Grasses*. This achievement could never have been possible under such circumstances except as a result of the impelling drive of a sustained fervor in pursuit of a high and compelling ideal.

About this time Mr. Silveus discovered that the first edition of *The First Book of Grasses* was running out. The publishers believed, and rightly, that the original and limited demand had been met so completely as to render future demand so small that another edition was commercially not indicated. Mr. Silveus agreed; but to him the book had been so great a help that he felt it to be a must in the equipment of any beginner of the study of the grasses. Accordingly, he sought and obtained permission from both the author and the publisher to reprint it at his own expense, well knowing that the return of his money would be slow. This edition, a slightly modified version of the most excellent original, appeared in January, 1937, and is still available through his son, William I. Silveus, 832 Cambridge Oval, San Antonio, Texas.

By the example of his own experience of enthusiasm and success in learning grasses, and by pointing out to other laymen the means he had found useful in revealing the real interest inherent in a subject popularly believed to be both dry and forbiddingly difficult, it was his hope to stimulate a wave of interest on the part of other intelligent laymen in discovering for themselves, as he had done, that to learn about the grasses is actually both highly interesting and profitable.

During the course of his work on Texas grasses, Mr. Silveus became especially interested in two closely related and rather difficult genera, *Paspalum* and *Panicum*, with (according to Hitchcock) somewhat more than fifty and one hundred seventy-five species, respectively in the United States. Accordingly, he set himself to study them for the whole United States as he had studied grasses in general for Texas. By the time the manuscript was finished he estimated that he had traveled some 175,000 miles. This work extended in time over most of the interval between 1933, the publication date of *Texas Grasses*, and 1942, the publication date of *Paspalum* and *Panicum* of the United States.

The general plan for the latter was the same as for *Texas Grasses*; personal field acquaintance, collection, photographing and dissection, with the addition of line drawings to supplement photographs and to bring out details in dissected material.

Again Mr. Silveus, with a truly missionary spirit, bore all the costs of publication; but the high degree of specialization, the difficulty naturally inherent in these genera and their comparative economic unimportance, greatly limited demand. The consuming interest of the author just wasn't as contagious as he had hoped it would be, the wealth of illustration in the book notwithstanding. The result was that this venture was far from being a financial success—which doubtless was no surprise to Mr. Silveus.

The financial crash of 1929 and the subsequent depression of the thirties caught Mr. Silveus about midway in his work on *Texas Grasses*. Having attained considerable economic success on the principle that it is man's first duty both to himself and to society to live righteously, to labor industriously, to practice frugality and thus to achieve and maintain individual economic independence, he deplored the drastic remedial measures to which national resort was had in the early thirties to combat wholesale unemployment. He felt that whereas great industrial and commercial concerns were able in large measure to shift their taxes to the consumer, and whereas persons of low economic status escaped taxes simply by having nothing to tax, the great middle class, with no escape, was thus forced to shoulder a greatly disproportionate share of the huge national tax burden. He felt that this procedure ran counter to, and prevented the operation of, the natural processes by which he had attained success—processes which justly reward industry and thrift, and which equally justly penalize sloth and waste. He phrased some of his views in poetic but positive and forthright language and published them in an interesting pamphlet which he called *Nature's Way*.

A rugged, positive, poetic individualist with courage to pursue the right as he conscientiously saw it; a man who, having become modestly wealthy at fifty years of age, turned aside from the path of successful wealth accumulation to embark with missionary zeal upon an entirely different and financially expensive path, but a path along which he hoped to lead a great

conservationist army of laymen and thus to render a real and lasting service to his fellow man while gladly contributing his time and defraying all the costs: this was William Arrents Silveus. His eminent success in a field totally foreign to that of his profession of the law probably stands with rare parallel in history.—B. C. THARP, UNIVERSITY OF TEXAS.

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